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PATENT SPECIFICATION

424,236

Application Date: Feb. 12, 1934. No. 4669/34.

Complete Specification Accepted: Feb. 18, 1935.

COMPLETE SPECIFICATION

Improvements in Apparatus for Drying Coal or other Granular Materials

I, RONALD MERVYN NORTON, of Sandford Hall, Claverley, in the County of Stafford, a British Subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to apparatus for drying coal or other granular materials by forcing the material to be dried through a casing by means of a screw conveyor, and simultaneously forcing hot gases through the casing. If the conveyor consists of a shaft carrying a helical blade fitting closely within a cylindrical casing, the hot gas is forced to take a helical path through the casing, and is thus brought into extremely intimate contact with the material to be dried. This has two results, the first being that if an adequate volume of gas is to be passed through the casing the diameter must be made inconveniently large and the second being that the resistance to the passage of the gas is increased substantially, so that only a comparatively small amount of material can be dried in an apparatus of a given size. Moreover, the risk of recondensation of the evaporated moisture is increased, since the moisture must be carried away fairly quickly if it is not to condense again. On the other hand, if the hot gases are allowed to pass straight through the casing, they do not come into sufficiently intimate contact with the material.

The present invention aims primarily at controlling or entirely preventing the amount of recondensation. This is effected in two ways which may advantageously be used together. The first way consists in making the casing double, that is to say, with an outer part through which hot gases first flow in indirect contact with the material, and with an inner part through which the gases next flow in direct contact with the material, and by providing one or more by-pass connections for the gases between the outer and inner parts of the casing at a point or points in the latter well removed from its main gas inlet, so that hot gas is admitted direct from the outer part to the inner part and thus prevents or minimizes recondensation at points where the gases are heavily laden with moisture. Particularly effective control of the operation is obtained by providing each by-pass with a variable control valve.

The second way consists in using a conveyor which forces the gases into intimate contact with the material and yet does not impose too much resistance to the flow of the gases. Such a conveyor, according to the invention, has blades which, while all running substantially helically, are differently shaped at different parts of the length of the conveyor shaft. Over at least one part of the length of the shaft the blades are adapted to force both the gases and the material to take a helical path through the casing, but over at least one other part of the length of the shaft parts of the blades are removed so as to form openings through which the gases may take a substantially more direct path through the casing, that is to say, may flow through the casing fairly easily. Thus, in order to combine intimate contact of the gases and material with such speed of flow as to reduce the risk of recondensation, sections of the two kinds of blades may be used alternately and be so arranged that each section constitutes less than one complete turn, so that in effect the cross-section of the gas path is increased in comparison with that which would be available if the blade that forces the gases and material to take a helical path made one complete revolution or more around the shaft. Further, in order to carry away quickly the moisture taken up from the material directly it enters the casing, that part of the conveyor which is first encountered by the material is formed with blades that allow the moisture-laden gases to pass rapidly over the material.

When, as is preferred, both methods of preventing recondensation are employed simultaneously, the shaft should

[*Price* 1/-]

carry blades that force the gases and material to take a helical path from the end at which the gases enter to the first by-pass, and blades offering easier flow of the gases from that by-pass to the end at which the material enters the casing, and the first-mentioned blades may be continuous or may alternate with blades of the other kind. It will be appreciated that one of the functions of the by-pass is to introduce additional gases into the casing and that if this is to be done without back pressure being set up a larger cross-sectional path must be provided after the by-pass than before it.

In order that the invention may be easily understood and readily carried into effect, one apparatus constructed in accordance therewith will now be described by way of example, with reference to the accompanying drawings in which,

Figure 1 shows an elevation of the apparatus partly in section, and

Figure 2 is a section on the line II—II in Figure 1.

The apparatus includes a casing having an inner part 1 and an outer part 2. At one end the inner part 1 of the casing is connected by a pipe 3 to a fan, while the outer part 2 of the casing is connected by a pipe 4 to a furnace from which hot air is drawn through the pipe 4 to the outer part 2 of the casing. Wet coal is supplied to a hopper 5 and passes downwards through a rotary star valve 6 to the part 1 of the casing. This coal is forced through the part 1 of the casing in counter-current to the hot air by means of a conveyor comprising a shaft 7 carrying a number of sections of two different kinds of blade 8 and 9 respectively. The blades 8 are helical, and their edges nearly come into contact with the inner wall of the part 1 of the casing, so that over those lengths of the conveyor that are formed with blades 8 both the material and the hot air are forced to travel in helical paths and the material comes into very intimate contact with the hot air. The blades 9 are formed with gaps through which the hot air can pass axially, so that while these blades serve to drive the material through the casing they offer comparatively little resistance to the flow of the hot gases.

The material leaves the casing through a pipe 10 controlled by a star valve 11.

The risk of recondensation is minimized by passing the incoming hot air through the outer part 2 of the casing in counter-current to the air flowing through the part 1 of the casing, and in addition by providing by-pass connections between the parts 1 and 2 of the casing at points where hot air has become heavily laden with moisture. These by-pass connections are shown at 12 and 13 and each is provided with a variable control valve 14. The by-pass connections constitute, it will be understood, means for introducing hot gas directly into the casing and thus boosting the drying towards the end of the gas flow. The conveyor shaft 7 is provided with blades of the type shown at 9 over that part of its length lying between the hopper 5 and the by-pass 13. This serves two purposes; first it ensures the provision of a larger cross-sectional path for the gases between the hopper 5 and the by-pass 13 than in the part of the casing before the by-pass 13, and so prevents any back pressure being set up in the latter part, and secondly it allows the relatively cold and heavily moisture-laden gases to be removed rapidly from the casing 1.

Between the by-pass 13 and the inlet for the gases into the inner part 1 of the casing, the blades 8 and 9 are arranged alternately, each length representing about three-quarters of a complete turn.

In cases in which the conveyor shaft is so long that it is necessary to support it by one or more intermediate bearings in the casing, the shaft is preferably provided, on both sides of each such bearing, with blades which permit substantially straight passage of the gases through the casing. By this means the restriction of the air passage caused by the bearing supports is counteracted.

It will of course be understood that it is not necessary for any of the blade sections to be truly helical, i.e. to be of constant pitch, and indeed it is sometimes advantageous to vary the pitch either at the beginning or at the end of the conveyor shaft.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An apparatus for drying coal or other granular material by forcing the material to be dried through a casing by means of a screw conveyor and simultaneously forcing hot gases through the casing, in which the casing is made double to allow hot gases to flow first through the outer part in indirect contact with the material and then through the inner part in direct contact with the material, and in which one or more by-pass connections for the gases are

provided between the outer and inner parts of the casing for the purpose of admitting hot gas from the outer part direct to the inner part at a point or points in the latter well removed from its main gas inlet so as to prevent or minimize recondensation at points where the gases are heavily laden with moisture.

2. An apparatus according to Claim 1, in which each by-pass is provided with a variable control valve.

3. An apparatus for drying coal or other granular materials by forcing the material to be dried through a casing by means of a screw conveyor and simultaneously forcing hot gases through the casing, in which the conveyor shaft is provided with blades which, while all running substantially helically, are differently shaped at different parts of the length of the shaft, the blades over at least one part being adapted to force both the gases and material to take a helical part through the casing and the blades over at least one other part having parts removed so as to form openings through which the gases may take a substantially more direct path through the casing, for the purpose set forth.

4. An apparatus according to Claim 3, arranged for counter-current flow of the gases and material, in which the part of the conveyor first encountered by the material is formed with blades allowing the moisture-laden gases to pass rapidly over the material.

5. An apparatus according to Claims 1 and 4, in which the conveyor is formed with blades allowing the moisture-laden gases to pass rapidly over the material between the first by-pass connection encountered by the gases and the inlet for the material.

6. An apparatus according to Claim 3 having a number of sections of each kind of blade arranged in alternating fashion so as to combine intimate contact of the gases and material with a gas flow capacity adapted to minimize recondensation.

7. An apparatus for drying coal constructed substantially as described with reference to the accompanying drawings.

Dated this 12th day of February, 1934.
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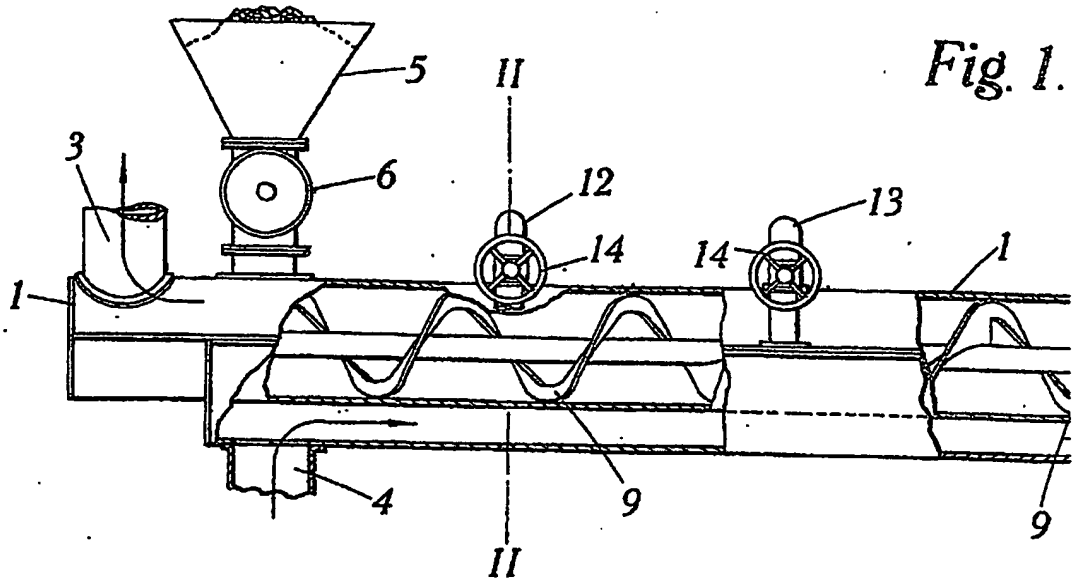
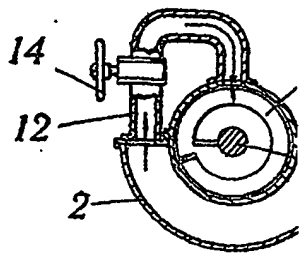


Fig. 1.

Fig. 2.



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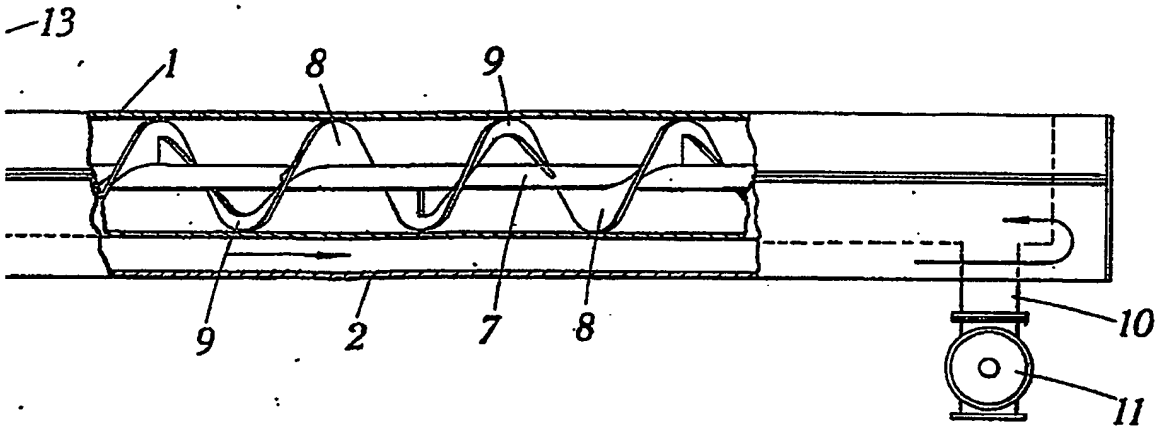

Fig. 2.

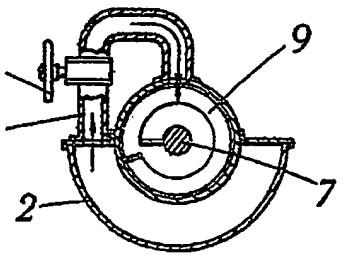

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Fig. 1.

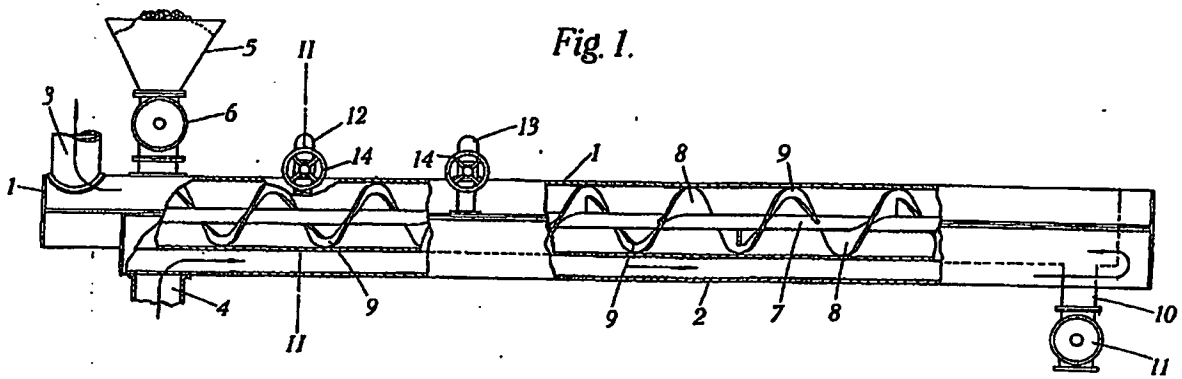
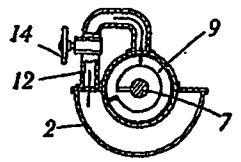


Fig. 2.



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